Complementing and analyzing the CORDEX-EUR11 ensemble in the framework of ReKliEs-De

Steger[1], C., J. Brauch[1], K. Radtke[2] and B. Früh[1]

[1] Deutscher Wetterdienst (DWD), [2] Brandenburgische Technische Univeristät Cottbus (BTU)

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The latest generation of climate projections for the 21st century are build on new emission scenarios based on Representative Concentration Pathways (RCPs). Within the world wide coordinated effort of the Coupled Model Intercomparison Project Phase 5 (CMIP5), their impact on climate is simulated with global models of the climate system. A sample of the global simulations is dynamically downscaled for Europe in the framework of EURO-CORDEX. Further simulations, with analysis focus on Germany and the river catchments draining into Germany, are conducted within the framework of the project ReKliEs-De to account for the full range of model variability. Here we present preliminary results from this unique ensemble of high resolution climate projections.

Data base

At the time of writing, 14 simulations for the CORDEX-EUR11 domain for the historical period and RCP8.5 are available. Within ReKliEs-De the existing CORDEX-EUR11 simulations are complemented by the simulation show in Tab. 1 in order to create a unique ensemble of high resolution climate projections. The results presented here are based on the available CORDEX-EUR11 simulations and the two simulations with COSMO-CLM and boundary conditions from MIROC5 and CanESM2 conducted the German Meteorological Service (DWD) within ReKliEs-De. The analysis will be repeated as soon as more simulations become available.

Tab. 1: Simulations on CORDEX-EUR11 domain planned within ReKliEs-De.

finished | running | not planned

	CCLM	REMO	WRF	STARS	WETTREG
MPI-ESM-LR RCP 2.6	BTU	EURO-CORDEX	UHOH	PIK	PIK
MPI-ESM-LR RCP 8.5	EURO-CORDEX	EURO-CORDEX	EURO-CORDEX	PIK	PIK
HadGEM2ES RCP 8.5	EURO-CORDEX	HZG	UHOH	PIK	PIK
EC-EARTH RCP 8.5	EURO-CORDEX	HZG	UHOH	PIK	PIK
CNRM-CM5 RCP 8.5	BTU	HZG	X	PIK	PIK
CanESM2 RCP8.5	DWD	HZG	X	PIK	PIK
MIROC5 RCP 8.5	DWD	HZG	UHOH	PIK	PIK

Model bias

Fig. 1 shows the temperature (TAS) and precipitation (PR) bias (spatial average for Germany) of all available simulations for the period 1971-2000 compared to E-OBS.

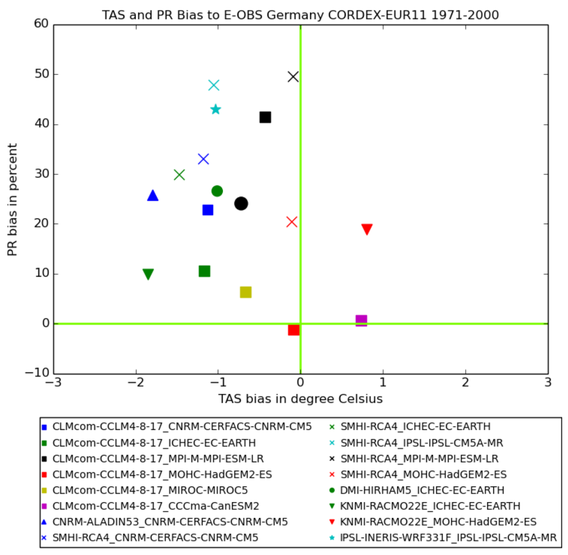

Fig. 1: TAS and PR bias (average for Germany 1971-2000) of all available CORDEX-EUR11 simulations compared to E-OBS.

Summary

- **nearly all EURO-CORDEX simulations suffer from a cold and wet bias over Germany for the period 1971-2000 compared to E-OBS**
- **temperature will increase by 1,4°C for the near future and 3,9°C for the distant future (multi-model-mean) compared to 1971-2000**
- **precipitation will increase by 5,1% for the near future and 10% for the distant future (multi-model-mean) compared to 1971-2000**
- **strong increase in temperature in all seasons until the end of the century**
- **precipitation increase will be strongest in winter and spring**

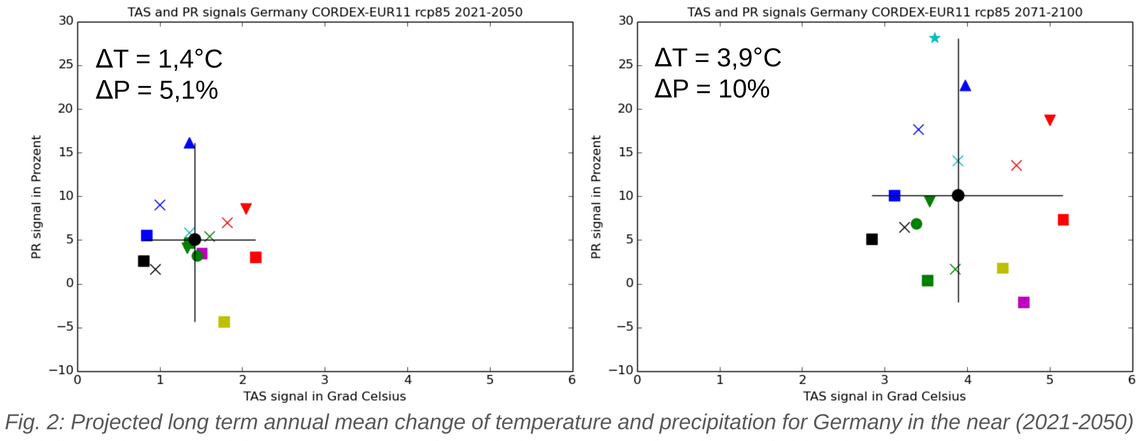

Fig. 2: Projected long term annual mean change of temperature and precipitation for Germany in the near (2021-2050) and distant (2071-2100) future compared to the period 1971-2000 of each models historical simulation.

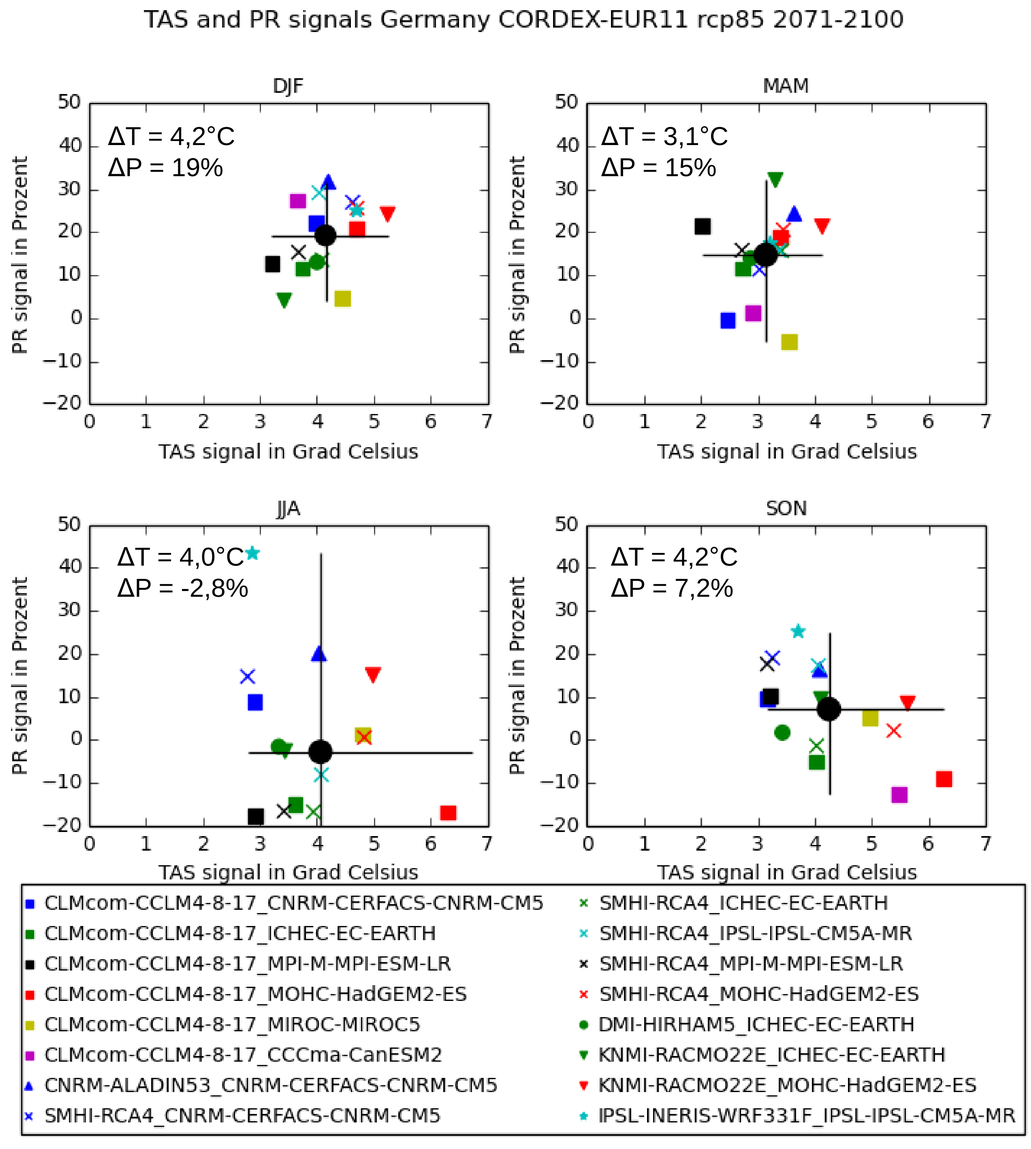

Fig. 3: As Fig. 2 but for seasons and distant future (2071-2100).

It becomes apparent that most GCM-RCM combinations suffer from a cold and wet bias for this region. Furthermore, there is evidence that the temperature bias is determined to a large degree by the global model (simulations with the same GCM are indicated by the same colors in all figures), while the RCMs have stronger influence on the simulated precipitation amount (simulations with the same RCM are indicated by the same form in all figures).

Projected change of temperature and precipitation

Fig. 2 reveals the temperature (abscissa) and precipitation (ordinate) signals in RCP8.5 of all simulations compared to the period 1971-2000 of each models historical simulation. The multi-model-mean indicates a warming of 1,4°C and a precipitation increase of 5,1% for the near future and of 3,9°C and 10% for the distant future. For the near future the projected changes in individual simulations cover a range from less than 1°C to more than 2°C for temperature and from a decrease in precipitation of 5% to an increase of more than 15%. For the distant future the model spread is even larger, indicating more uncertainty for the projected results for that period. For temperature the projected change covers a range from less than 3°C to more than 5°C. For precipitation the values reach from a slight decrease to an increase of nearly 30%.

The results for the different seasons in the distant future of scenario RCP8.5 are shown in Fig. 3. There will be increase in temperature around 4°C in winter, summer and fall and of 3,1°C in spring. For precipitation the situation is different. Precipitation will increase mostly in winter (19%) and spring (15%), while the summers are expected to be slightly drier. The projected change in precipitation, especially in summer, is more uncertain than the projected change in temperature, because the individual simulations differ strongly and the projected values cover a range of nearly +/- 50%.

Deutscher Wetterdienst, Climate and Environment
Contact: Christian Steger (christian.steger@dwd.de)